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**Dosimetric characterization of carbon fiber stabilization devices for postoperative particle therapy**

S. Russo[1], E. Mastella[1], S. Molinelli[1], A. Mirandola[1], D. Panizza[1], A. Mairani[1], G. Magro[2], P. Fossati[3], M.R. Fiore[3], A. Gasbarrini[4], S. Boriani[4], F. Valvo[5], M. Ciocca[1]
[1]*Fondazione CNAO, Medical Physics Unit, Pavia, Italy*
[2]*Università di Pavia, Physics Department, Pavia, Italy*
[3]*Fondazione CNAO, Clinical Radiotherapy Unit, Pavia, Italy*
[4]*Istituto Ortopedico Rizzoli, Department of Oncologic and Degenerative Spine Surgery, Bologna, Italy*
[5]*Fondazione CNAO, Clinical Directorate, Pavia, Italy*

**Purpose or Objective:** Surgical implant fixation is a common technique in case of spinal and paraspinal tumors, usually considered good candidates for particle therapy (PT).Traditional orthopedic metal implants significantly differ from normal tissues in terms of density and composition, leading to substantial perturbation effects on radiation beams. Recently a Carbon Fibers Reinforced(CFR)-PEEK stabilization device completely metal free has become available (CarboFix Orthopedics). This device is supposed to be more suitable for PT where treatment accuracy can be highly compromised by uncertainties in particles range. The aim of this study was to investigate and compare uncertainties related to the use of titanium and CFR-PEEK screws in terms of image quality, reconstruction artifacts, contouring and dose calculation accuracy, for both proton and carbon ion beams.

**Material and Methods:** Two vertebral body models, hosting two different types of orthopedic implants (a titanium and a CFR-PEEK implant), were positioned inside a water phantom to simulate real patients configuration. A CT scan was acquired according to our clinical protocols to evaluate induced HU artifacts and their impact on contouring uncertainties. Titanium and CFR-PEEK water equivalent path lengths (WEPL) were measured and implemented in our treatment planning systems (TPS). Implants and artifacts were contoured for proper material density assignment in the TPS HU to WEPL calibration curve. Plans were optimized for both proton and carbon ions, with and without HU correction, to evaluate the impact of CT artefacts and contouring uncertainties on dosimetric calculation accuracy, in comparison with MC simulations. Two patient cases, previously treated in our center were analyzed in terms of target and OAR dose deviation due to wrong material assignment, with respect to the clinically approved plan.

**Results:** CFR-PEEK implants did not cause appreciable HU artifacts on CT images compared to titanium ones. Significant differences in dose distribution between TPS and MC simulations in high-Z region were observed, while a good agreement was found for CFR-PEEK screws. Inaccurate material assignment did not significantly vary the clinical case 3D dose distribution for CFR-PEEK implants (<1%). Titanium screws made difficult to correctly contour both targets and OARs. Moreover, local dose deviations up to 20% can be find when HU uncertainties are not correctly managed. Besides efforts made towards a robust optimization with respect to potential beam perturbation, dose delivered to healthy tissues positioned behind targets along the implant trajectory can be substantially altered.

**Conclusion:** CFR-PEEK stabilization devices are more suitable than commonly-used titanium devices for PT of patients with orthopedic implants, leading to less image alteration and consequently reduced contouring uncertainties together with a significantly higher dosimetric treatment planning accuracy.

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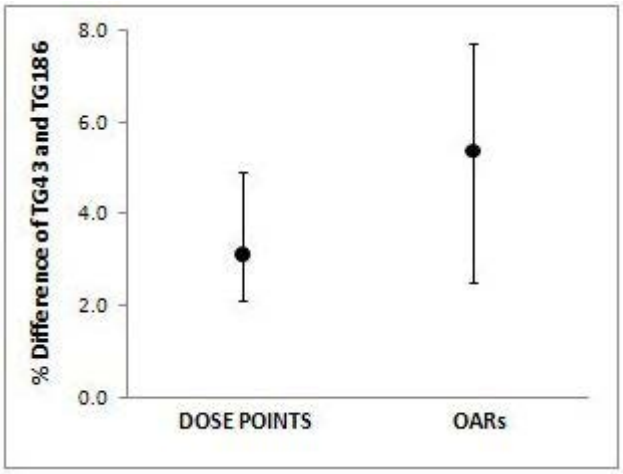
**Retrospective dosimetric comparison of TG43 and a commercially MBDCA for image-based plesiotherapy**

A. Pereira[1], S.P. Sara Pinto[1], T.V. Teresa Viterbo[1]
[1]*Instituto Português de Oncologia do Porto Dr. Francisco Gentil Porto, Medical Physics Dept, Porto, Portugal*

**Purpose or Objective:** To compare dosimetry plans using a commercially model based dose calculation algorithm (MBDCA) following TG186 recommendations, and the conventional TG43 method in an 192Ir high dose rate (HDR) brachytherapy (BT) procedure for the treatment of skin lesions.

**Material and Methods:** Plesiotherapy treatment was performed in three patients with lesions localized in the pre auricular region (patient 1), the nasal dorsum (patient 2) and the nasal tip (patient 3). The lesions (PTV) were marked with radiopaque markers. Patients were immobilized with a thermoplastic mask. A bolus slab of 2 mm thickness and plastic catheters were applied over the mask, and the whole set was fixed with two bolus slabs. All dosimetries plans were based on a CT with 1,25mm slices thickness and the dose was delivered with a micro-Selectron afterloader. Treatment plans were performed using both the TG43 and TG186 dose calculation methods of the Oncentra Brachy v4.5 treatment planning system (TPS). Analysis included dose to the OARs (lens, ocullar globe and optic nerves) and to the prescription points (3 mm tissue depth). The TG186 results were obtained using the standard accuracy level option of model-based algorithm (Oncentra Brachy-Advanced Collapsed cone Engine (ACE), Elekta), resulting in calculation times between 7 – 10 min.

**Results:** In all cases, TG 43 overestimated the doses in the prescription points and in the OARs, in the range of 3.0% and 6.2%, respectively (Figure 1).




**Conclusion:** Although differences were found between the dosimetrie plans obtained with the TG43 and model based dose calculation algorithm following TG186 recommendations, they are minor in terms of prescription dose points for skin lesions, since a 5% difference is within clinical tolerances in brachytherapy.

**EP-1555**

**On the RapidArc tests by Ling 2008: towards flexibility and troubleshoot with a new family of plans**

G. Nicolini[1], E. Vanetti[1], A. Clivio[1], S. Presilla[1]
[1]*Ente Ospedaliero Cantonale, Servizio di Fisica Medica, Bellinzona, Switzerland*

**Purpose or Objective:** At the introduction of RapidArc (RA) technique, the paper by Ling et al 2008 has constituted a reference, proposing RA commissioning machine quality assurance (QA) tests. Thanks to the free availability, many centers have implemented these tests in their periodic QA. Recently, tests identified as T2 (variation of dose rate DR and